Relative Fishing Powers of On-Bottom Trawlers Operating in the Canadian Portions of Georgia and Juan De Fuca Straits, 1954-84

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RELATIVE FISHING POWERS OF ON-BOTTOM TRAWLERS OPERATING IN THE CANADIAN PORTIONS OF GEORGIA AND JUAN DE FUCA STRAITS, 1954-84

by

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ABSTRACT

Westrheim, S. J. and R. P. Foucher. 1985. Relative fishing powers of on-bottom trawlers operating in the Canadian portions of Georgia and Juan de Fuca straits, 1954-84. Can. MS Rep. Fish. Aquat. Sci. 1856: 53 p.

Relative fishing powers (RFPs) were calculated for the on-bottom trawlers landing groundfish for human consumption from the Canadian portions of Georgia and Juan de Fuca straits during October-March 1954-55 through 1983-84. Landing statistics for Pacific cod, the predominant species, were used for the linear regression of LPUEs (landing per unit effort), at 40% qualification level, on horsepower class (100-unit intervals), gear-class 3 (double gear + drum). RFPs for gear-class 3 (double gear + drum), were 0.64, 0.81, 1.00, 1.18, 1.35, 1.54, 1.71, 1.90, 2.07, and 2.25, respectively, for horsepower-classes 1 (100 hp) - 10 (899 hp). RFPs for gear-class 3 were 1.417 with respect to gear-class 1 (single gear), and 1.336 with respect to gear-class 2 (double gear).

RESUME

Westrheim, S. J. and R. P. Foucher. 1985. Relative fishing powers of on-bottom trawlers operating in the Canadian portions of Georgia and Juan de Fuca straits, 1954-84. Can. MS Rep. Fish. Aquat. Sci. 1856: 53 p.

On a calculé les capacités relatives de pêche (CRP) pour les chalutiers de fond qui pêchent le poisson de fond destiné à la consommation humaine dans les zones canadiennes des détroits de Géorgie et de Juan de Fuca d'octobre à mars durant la période allant de 1954-1955 à 1983-1984. On a utilisé les statistiques sur les débarquements de morue du Pacifique, l'espèce prédominante, pour établir la régression linéaire des DUE (débarquements par unité d'effort), à un niveau de qualification de 40%, en fonction de la catégorie de puissance (à intervalle de 100 unités), pour la catégorie d'engin 3 (engin double + tambour). Les CRP pour la catégorie d'engin 3 (engin double + tambour) étaient de 0,64, 0,81, 1,00, 1,18, 1,35, 1,54, 1,71, 1,90, 2,07 et 2,235 respectivement, pour les catégories de Puissance 1 (100 cv) - 10 (899 cv). Les coefficients de CRP de la catégorie d'engin 3 étaient de 1,417 par rapport à la catégorie d'engin 1 (engin simple) et de 1,336 par rapport à la catégorie d'engin 2 (engin double).

INTRODUCTION

Relative fishing powers (RFPs) are employed to standardize trawling effort, an essential step in our investigations into the population dynamics of groundfish stocks exploited by the dynamic trawl fishery of British Columbia. Recent reports have dealt with: all-species in Georgia Strait (Area 4B) (Ketchen 1979); Pacific ocean perch (Sebastes alutus) in Queen Charlotte Sound (Areas 5A+5B) (Ketchen 1981); rock sole in northern Hecate Strait (Area 5D) (Stocker and Fournier 1984); and Pacific cod (Gadus macrocephalus) and its principal shelf co-habitants off southwest Vancouver Island (Area 3C), and in Queen Charlotte Sound and Hecate Strait (Areas 5C+5D) (Westrheim and Foucher 1985) (Fig. 1). Westrheim and Foucher (op. cit.) reviewed results of all past effort-standardization studies conducted in the B.C.-California region.

This report contains the results of calculating RFPs of on-bottom trawlers operating in the Canadian portions of Georgia and Juan de Fuca straits (Area 4B) during October-March 1954-55 through 1983-84.

MATERIALS AND METHODS

MATERIALS

Data used in this analysis included only landing records collected by Port Liaison Officers, who interview Canadian trawler captains when catches are landed for sale. Data records begin in 1954, and are continuous to date. These "interviewed" landings usually comprised at least 50% of the annual trawl landings. Each record includes: name of vessel, date of landing, location(s) trawled (major area, minor area, ground), depth range trawled, time trawled (nominal effort), and weight of each species retained for sale. Continuing records are maintained for each vessel of its tonnage, main engine horsepower, deck gear, and the presence or absence of navigational aids (RDF, RADAR, LORAN, and echo sounder).

METHODS

The underlying model used to derive relative fishing power was that of Gulland (1956), as modified by Westrheim and Foucher (1985). Four steps are involved, as follows:

Step 1. Compile landings, effort, and landings per unit effort (LPUE) by vessel class[a] by year, and select standard vessel class.

Step 2. Calculate mean relative fishing power for each vessel class with respect to the standard vessel class.

$$\overline{RFP}_i = \sum_{j=1}^{n} (LPUE_{ij}/LPUE_{sj})/n_j$$

where $\overline{RFP}_i$ = mean relative fishing power for vessel-class i,

$\overline{LPUE}_{ij}$ = landing per unit effort for vessel-class i in area-time cell j,

$\overline{LPUE}_{sj}$ = landing per unit effort for the standard vessel class in area-time cell j,

and n_j = number of area-time cells.

Step 3. Regress $\overline{RFPs}$ on vessel class.

$$\hat{RFP}_i' = a + b \text{ (vessel-class)}$$

$\hat{RFP}_i'$ = estimated relative fishing power for vessel-class i, uncalibrated with $\hat{RFP}'$ of the standard vessel class.

Step 4. Calculate relative fishing power of each vessel class smoothed by regression.

$$\hat{RFP}_i = \hat{RFP}_i'/\hat{RFP}_s'$$

where $\hat{RFP}_i$ = smoothed relative fishing power for vessel-class i,

$\hat{RFP}_i'$ = estimated relative fishing power for vessel-class i, uncalibrated with $\hat{RFP}'$ of the standard vessel class,

and $\hat{RFP}_s'$ = estimated relative fishing power for the standard vessel class.

Species. Pacific cod is the dominant species in the on-bottom trawl fishery of Georgia and Juan de Fuca straits. Westrheim (1980) reported that during October-March 1945-46 through 1959-60, Pacific cod comprised 56% of the

[a] The reason for using vessel class rather than individual vessels, will be discussed later.

landings (excluding spiny dogfish) for human consumption, and during 1960-61 through 1976-77, 60%. Other individual species listed were English sole (19 and 16%) and lingcod (4 and 5%). During 1945-46 through 1983-84, Pacific cod comprised 45.0% of the all-species landings for human consumption (Table 1).

Accordingly, we elected to standardize the effort of on-bottom trawlers "targeting" on Pacific cod. Not only is this species dominant in the trawl landings, but it has been subject to a steady demand throughout the history of the fishery. The resulting RFPs should be applicable to effort expended on secondary species landed by the on-bottom trawl fleet.

Time. The Area 4B on-bottom trawl fishery is seasonal for all species. Principal production period is October-March (Westrheim 1980). During 1945-84, 77.9% of the Pacific cod landings occurred during October-March -- 47.6% during January-March, and 30.3% during October-December (Table 2). This seasonality is primarily due to three factors -- extensive trawl closures during April-September; seasonal variations in availability; and substantially larger catch rates on the offshore grounds, particularly during April-September (Westrheim, op. cit.). Therefore, the time period for the present analysis is the six-month period October through the following March.

Space. Within Area 4B, there are 11 minor statistical areas (MSAs) -- 12-20 and 28-29 (Fig. 1). MSAs 14 and 17-20 produce 94.5% of the Pacific cod landings (Table 3). Principal MSA is 18, which has produced the greatest proportion of cumulative landings (33.3%), as well as a sustained production during 1945-84. MSA 19 produced the second largest cumulative landings (24.6%), but production was minor prior to 1975. Only MSA 20 production exhibited a non-seasonal pattern.

It is evident from Table 3 and Figure 2 that cod-production records are dissimilar in magnitude and trend among the important MSAs, hence initial effort-standardization analyses dealt with Area 4B as a whole.

Utilization. Pacific cod landings during October-March for human consumption comprised 98.6% of the cumulative 1955-56 through 1983-84 landings of that species (Table 4). Secondary categories were animal food (0.7%, mostly during 1955-56 through 1958-59), and discard-at-sea (0.4%, a voluntary reporting option begun during 1965-66 through 1968-69). Accordingly the present analysis excluded all categories of utilization except human consumption.

Interviewed landings. Overall interview coverage was 57.0% for Pacific cod landings from Area 4B -- 34.8 - 95.2% among MSAs (Table 5). Variable coverage was attributed primarily to port of landing. At times, appreciable proportions of the landings from some MSAs are landed at small plants along the east coast of Vancouver Island, where no port liaison officer is stationed.

Vessels. The transitory nature of participation by individual vessels precluded use of their records except when grouped in classes -- by gear and horsepower or tonnage. A total of 151 individual vessels landed at least one tonne of Pacific cod during the study period, but 66.9% operated less than 4 years, and 33.1% operated only one year (Table 6). One vessel landed cod in 22 individual years, and another six in 12-20 years.

Three of the nine gear classes[a] accounted for 96.7% of the Pacific cod landings -- 69.0% by double + drum; 17.7% by single, and 10.0% by double (Table 7). Gear-class 1 predominated during 1955-56 through 1958-59, but produced negligible landings (<50 t) after 1961-62 (Appendix table 1c) and negligible effort (<200 h) after 1963-64 (Appendix table 1d). For Gear-class 2, comparable years were 1963-64 for landings, (Appendix table 2c) and 1965-66 for effort (Appendix table 2d). Gear-class 3 (double + drum) produced negligible landings prior to 1963-64 (Appendix table 3c) and effort prior to 1961-62 (Appendix table 3d), but predominated in the Pacific cod fishery after 1964-65. During 1960-61 through 1964-65, contributions of the three gear classes were approximately equal (232-384 t), however, the limited overlap on the time series for the three gear classes is evident. For the overall analysis of Area 4B data, gear-class 3 was selected as the standard.

Gear-class 3 had two advantages. First, the spread of the trawl doors was 1.47 times that for single gear, at least for Tonnage-class 3 (25-49) of Ketchen (1951). Increased door-spread improves gear efficiency insofar as "herding" is increased. Second, the net drum on the vessel's stern expedites deploying and retrieving the net, and hence increases the hauls/day, or at least time the net is on the bottom. Expediting gear handling also increases vessel efficiency insofar as better contact is maintained with the often mobile schools of groundfish.

Vessel class. The choice of tonnage class (50-unit intervals) or horsepower class (100-unit intervals) fell to the latter. Tonnage class was rejected because horsepower increased temporally within tonnage classes (Table 8), whereas tonnage exhibited little or no temporal trend within horsepower classes (Table 9). The same phenomena were noted for vessels trawling for offshore shelf species (Westrheim and Foucher 1985).

Unfortunately, intermittent overlap precluded direct calibration of gear-class 3 with gear-classes 1 and 2. During 1960-61 through 1964-65 when cumulative annual landings were similar (232-384 t; Table 7), all three gear classes produced negligible (<28 t) landings in two years (Appendix tables 1c, 2c, and 3c) -- 1962-63 and 1964-65 for gear-class 1; 1961-62 and 1962-63 for gear class 2; and 1960-61 and 1961-62 for gear-class 3. Therefore, an indirect calibration was developed for horsepower-classes 1, 2, and 3. The method utilizes mean LPUEs for paired gear classes (1 and 2; 2 and 3; 1 and 3) within each horsepower class (1-3). The three steps involved are listed below, using as an example, the data for horsepower-class 2 (Table 14).

Step 1. Calculate mean LPUEs for each of paired gear classes, for 1 and 2; 2 and 3; 1 and 3. For instance, for gear-classes 1 and 2:

$\overline{LPUE}_{i2.1}$ = mean of LPUEs in gear-class 2, paired with LPUEs in gear-class 1, from horsepower-class i.

= 108

[a]See Table 7 for descriptions of relevant gear classes.

$\overline{LPUE}_{i2.3}$ = mean of LPUEs in gear-class 2, paired with LPUEs in gear-class 3, from horsepower-class i.
= 107

Step 2. Calculate estimated LPUE for gear-class 3, when only gear-classes 1 and 2 are available, by horsepower class:

$$\hat{LPUE}_{i3} = (\overline{LPUE}_{i3.2})(\overline{LPUE}_{i2.1})/(\overline{LPUE}_{i2.3})$$
$$133 = (132)(108)/(107)$$

where $\hat{LPUE}_{i3}$ = estimated LPUE for gear-class 3 in horsepower-class i,

$\overline{LPUE}_{i3.2}$ = mean LPUE for those in gear-class 3 which were paired with LPUEs in gear-class 2, from horsepower-class i,

$\overline{LPUE}_{i2.1}$ = mean LPUE for those in gear-class 2 which were paired with LPUEs in gear-class 1, from horsepower-class i,

and $\overline{LPUE}_{i2.3}$ = mean LPUE for those in gear-class 2 which were paired with LPUEs in gear-class 3, from horsepower-class i.

Step 3. Calculate relative fishing power of gear class 3 with respect to gear-class 1, by horsepower-class:

$$RFP_{i3.1} = (\hat{LPUE}_{i3})/(\overline{LPUE}_{i1.2})$$
$$1.198 = 133/111$$

N.B. LPUE pairs for gear-classes 1 and 3 were not used in subsequent analyses for two reasons:

(1) unrealistic RFP values for horsepower-classes 1 and 3; and
(2) too few pairs for horsepower-class 3 (see Table 14)

Qualification level. The conventional qualification method[a] was employed to provide "targetted" effort for cod which was used to calculate LPUE (landings per unit effort), the index of abundance. This procedure seemed appropriate because of the dominance of Pacific cod in the trawl

[a]Assigning all effort, attributed to an interviewed landing, to each species in the landing which comprises a pre-determined percentage (qualification level) of that landing.

landings for human consumption. Furthermore, the option-2 method (Westrheim 1983) was deemed inappropriate because of the small size, and poor delineation, of individual trawling grounds as well as the relatively low percentage interview coverage in some important MSAs.

Four arbitrary qualification levels were considered -- 0%, 20%, 40%, and 60% (Table 10). The 40% level was selected because LPUEs were very close to those for 60% QL (Fig. 3), but more landings were involved (Fig. 4). Qualification levels 0% and 20% were rejected, because they likely permitted the inclusion of landings in which other "targetted" species were included, such as spiny dogfish (Squalus acanthias) and walleye pollock (Theragra chalcogramma).

Summary. Thus, for our analysis, we selected Pacific cod landings, for human consumption, from Area 4B during October-March 1954-55 through 1983-84, at the 40% qualification level. Standard gear class was 3 (double + drum), and the standard vessel horsepower class was 3 (200-299 hp).

RESULTS

VESSELS

At the 40% qualification level, 127 individual vessels, in gear-classes 1-3, landed at least one tonne of Pacific cod for human consumption, in at least one year, from Area 4B during October-March 1954-55 through 1983-84 (Table 11). Of these, 88 (69.3%) were gear-class 3, and 28 (22.0%) horsepower-class 3, for at least part of the study period. Comparable number of vessels which were both gear-class 3 and horsepower-class 3 was 22 (17.3%).

Individual vessels remained relatively stable, with respect to gear class and horsepower class. Only 26 vessels (20.5%) changed gear class or horsepower class, and only one changed both -- one change in gear class (1 → 3), and two changes in horsepower class (1 → 2 → 3).

Notable is the transitory nature of the vessels in gear-class 3, with respect to time (Fig. 5). Participation by individual vessels ranged from 1 to 22 years but most (84%) were in the fishery less than 6 years. Only three vessels landed cod in more than 10 years.

LANDINGS

Cumulative interviewed landings from Area 4B by gear-class-3 vessels totalled 5,672 t, during October-March 1954-55 through 1983-84 (Table 12). Principal horsepower class, overall, was 3 (37.6%), but among MSAs, it was

class 2 for MSAs 14 and 17; class 3 for MSAs 18 and 19; and class 4 for MSA 20. MSA 20 is exposed to strong southerly winds during fall and winter, and hence is not attractive to the relatively small vessels which trawl elsewhere in Area 4B. Landings by horsepower-class-3 vessels comprised 41.4-47.7% of those from MSAs 17, 18, and 19, but only 25.5% for MSA 14, and 17.9% from MSA 20.

RELATIVE FISHING POWER

Detailed records used to compute RFPs for vessels landing Pacific cod from Area 4B are contained in Appendix tables 1-3, respectively, for gear-classes 1, 2, and 3, by horsepower class.

Gear-class 3. For vessels in gear-class 3, the array of $\overline{RFP}$s on horsepower class was linear (Fig. 6). Accordingly, a regression line was fitted with the following parameters: $a = 0.494$; $b = 0.194$; and $R^2 = 0.77$. RFP values ranged from 0.64 for horsepower-class 1 to 2.25 for horsepower-class 10 (Table 13).

Among MSAs, $\overline{RFP}$ arrays were generally disappointing due to poor RFP-horsepower correlations and/or discontinuous data (Table 13). MSAs 14, 17, and 20 exhibited poor correlations. MSAs 17 and 20 possessed discontinuous distributions.

Gear classes 1 and 2. RFPs of gear-class 3, with respect to gear-class 1 were 2.093 for horsepower-class 1, 1.198 for horsepower-class 2, and 1.132 for horsepower-class 3 (Table 14). With respect to gear-class 2, the corresponding RFPs were 1.697, 1.234, and 1.143. Evident inconsistencies in these results led to averaging the LPUEs over horsepower-classes 1-3, which produced values of 1.417 for gear-class 3 with respect to gear-class 1 and 1.336 for gear-class 3 with respect to gear-class 2. These latter two ratios were accepted as the "best available". Direct comparisons of gear-classes 1 and 3 yielded inconsistent results.

NOMINAL VERSUS STANDARDIZED EFFORT AND LPUE

Using Pacific cod as an example, nominal effort was substantially larger and nominal LPUE was substantially smaller than standardized effort and LPUE during 1954-55 through 1964-65, but both were relatively equivalent during 1965-66 through 1983-84 (Fig. 9; Table 15). Ranges of nominal/standardized ratios were:

	1954-55 - 1964-65	1965-66 - 1983-84
Effort	1.33 - 2.01	0.86 - 1.24
LPUE	0.50 - 0.75	0.81 - 1.16

Other studies. The initial study, of Area 4B was that by Ketchen (1979), who calculated standardized LPUEs for all-species landings for human consumption during October-March 1954-55 through 1977-78. His standard vessel class was defined as tonnage-class 3 (25-49 t), "double" (double and double + drum) gear. He adjusted his LPUEs to exclude the effect of targetting on spiny dogfish and walleye pollock, and computed "CPUEs" for Pacific cod by dividing the total Pacific cod landing in each "year" by the corresponding total standard fishing effort (op. cit.; Table 8). Standard fishing effort was calculated by dividing total all-species landings for human consumption (excluding spiny dogfish and walleye pollock) by standard "CPUE".

Ketchen et al. (1983; Fig. 7) modified their LPUEs "to account for a long-term increase in efficiency" -- a long-term increase in mean horsepower within his standard-class trawlers (Ketchen, pers. comm.). Appendix table 4 contains the unpublished computations they referred to.

For 1954-55 through 1980-81, standardized LPUEs for Pacific cod of Ketchen (unpublished) and this study exhibit similar trends (Fig. 8; Table 15). The substantial diversion for 1972-73 was attributed to "under-correction" for the singularly large landings of spiny dogfish (Ketchen et al. 1983; Fig. 4), during January-March 1973. Their relatively low "CPUEs" in 1977-78 and 1978-79 may have been due to a disproportionally low participation of their tonnage-class 3 (25-49 t) vessels in the MSA 19 fishery, where landings (and probably LPUEs) were anomalously high (Fig. 2).

DISCUSSION

For vessels in gear-class 3, RFPs, by horsepower class, were comparable to those on most of the offshore grounds, if all are calibrated to horsepower-class 3. For horsepower-class 1, Area 4B RFP was 0.64, compared with 0.66, 0.72, 0.66, and 0.31, respectively, for Areas 3C-N, 5A + 5B, 5C, and 5D (Westrheim and Foucher 1985). For horsepower class 10, corresponding values were 2.25 versus 2.16, 1.98, 2.21, and 3.42.

Comparison of nominal and standardized effort and LPUE in our study, for Pacific cod, yielded the expected difference for early years -- standardized effort less than nominal effort, and standardized LPUE greater than nominal LPUE. However, for the later years, standardized effort and LPUE differed little from nominal effort and LPUE. This apparent paradox is readily explained by the horsepower makeup of the fleet (see Appendix table 3). During 1975-76 through 1983-84, the principal horsepower classes were 2, 3, and 4, with RFP values of 0.81, 1.00. and 1.18, respectively. Since 82% of the landings and 88% of the effort were accounted for in these three classes, and fairly well distributed among them, little difference could be expected between standardized and nominal effort and LPUE.

Remarkable was the similarity in trends of LPUE ("CPUE") within and among studies in Area 4B. The unusual general stability of the fleet, in comparison to the offshore areas, is probably the principal cause. That is,

gear-class 3 and horsepower-classes 2-3 predominated during most of the study period, and participation by larger horsepower classes was negligible. Unfortunately, the transient nature of individual vessels precluded an analysis of their respective RFPs.

Differences between the studies include the scale of LPUEs and time of deviations of nominal LPUEs from standardized LPUEs. LPUEs of our study were larger overall, because of the relatively high qualification level (40%)--0% for Ketchen's studies. In our study, standardized LPUEs were substantially larger than nominal LPUEs during the early years when vessels smaller than the standard predominated. In the Ketchen studies, nominal LPUEs were substantially larger than standardized LPUEs in the later years, when vessels larger than the standard predominated.

A cautionary note is provided here. Specifically, the Pacific cod LPUEs for Area 4B as a whole should not be used in analyses of the cod stock(s) in Area 4B because of differences between the minor areas (Fig. 2). The anomalous fishery in MSA 19 (Fig. 2) is probably based primarily on an offshore cod stock. The MSA 19 fishery is currently under investigation.

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Table 1. Total landings (t) of all-species and Pacific cod from Area 4B, by 5-year periods, January-December 1945-84.

Period[a]	All-spp. (t)	Pacific cod (t)	Pacific cod %
1945-49	6,095	1,657	27.2
1950-54	10,004	4,055	50.5
1955-59	9,133	3,729	40.8
1960-64	6,705	2,996	44.7
1965-69	4,679	1,977	42.3
1970-74	6,549	2,990	45.4
1975-79	10,990	5,639	51.3
1980-84	10,072	5,871	58.3
Total	64,227	28,914	45.0

[a]1945-53 from Westrheim (1980)

Table 2. Total landings (t) of Pacific cod from Area 4B, by quarter-year and 5-year periods, January-December 1945-84.

Period[a]	Quarter-year I	II	III	IV	Total
1945-49	956	176	57	468	1,657
1950-54	2,149	508	354	1,044	4,055
1955-59	2,300	381	191	857	3,729
1960-64	1,564	480	118	834	2,996
1965-69	905	236	119	717	1,977
1970-74	1,675	435	182	698	2,990
1975-79	2,004	596	853	2,186	5,639
1980-84	2,204	675	1,029	1,963	5,871
Total	13,757	3,487	2,903	8,767	28,914
%	47.6	12.1	10.0	30.3	100.0

[a]1945-53 from Westrheim (1980).

Table 3. Total landings (t) of Pacific cod from Area 4B, by minor statistical area and 5-year periods, January-December 1945-84.

Period	Minor statistical area 14	17	18	19	20	Other[a]	Total
1945-49	126	329	958	?	26	216	1,657
1950-54	874	947	1,830	53	113	238	4,055
1955-59	728	768	1,429	298	178	328	3,729
1960-64	407	673	1,099	341	334	142	2,996
1965-69	130	395	639	298	356	159	1,977
1970-74	394	1,008	980	256	280	72	2,990
1975-79	454	370	1,723	2,423	466	203	5,639
1980-84	318	137	979	3,433	764	240	5,871
Total	3,431	4,627	9,637	7,104	2,517	1,598	28,914
%	11.9	16.0	33.3	24.6	8.7	5.5	100.0
1945-74							
Total	2,659	4,120	6,935	1,248	1,287	1,155	17,404
%	15.3	23.7	39.8	7.2	7.4	6.6	100.0
				Percent			
Quarter year							
I	49.4	77.0	59.7	19.5	28.4		47.6
II	14.9	8.9	11.5	5.7	24.9		12.1
III	8.9	1.4	2.9	21.7	24.6		10.0
IV	26.7	12.7	25.9	53.2	22.1		30.3
Total	99.9	100.0	100.0	100.1	100.0		100.0

[a]Other = MSAs 12, 13, 15, 16, 28, 29 and unknown

Table 4. Total landings (t) of Pacific cod from Area 4B, by utilization, and 5-year periods, October-March 1955-84.

	Utilization[a]							
Period[b]	1	2	3	4	5	6	7	Total
1955-59	3,026	91	-	-	-	-	-	3,117
1960-64	2,192	12	-	3	2	-	-	2,209
1965-69	1,550	12	-	2	-	4	-	1,568
1970-74	2,253	1	-	-	-	9	-	2,263
1975-79	3,743	-	-	1	-	41	-	3,785
1980-84	2,911	-	-	2	12	10	14	2,949
Total	15,675	116	-	8	14	64	14	15,891
%	98.6	0.7	-	0.1	0.1	0.4	0.1	100.0

[a]Utilization code: 1 = human consumption; 2 = animal food; 3 = reduction; 4 = dumped (not acceptable for sale); 5 = bait; 6 = discard (at sea); 7 = landed but not reported as sold.

[b]1955-59 = October 1955-March 1956 ... October 1959-March 1960; etc.

Table 5. Proportions (%) of total Pacific cod landings (t) from Area 4B which were interviewed, by minor statistical area and 5-year period, October-March 1955-84.

Period[b]		Minor statistical area					Other[a]	Total
		14	17	18	19	20		
1955-59	% Interv. (Total)	98.9 (542)	75.0 (840)	60.8 (1,103)	23.4 (286)	48.1 (52)	74.1 (205)	68.7 (3,028)
1960-64	% (T)	99.3 (290)	80.1 (418)	17.4 (968)	31.0 (306)	69.5 (118)	61.2 (103)	51.3 (2,203)
1965-69	% (T)	98.3 (115)	90.1 (423)	30.8 (558)	34.2 (281)	55.0 (111)	85.8 (120)	64.7 (1,608)
1970-74	% (T)	94.3 (333)	86.9 (953)	29.1 (796)	25.2 (242)	27.3 (77)	(100) (46)	61.5 (2,447)
1975-79	% (T)	96.4 (364)	40.4 (275)	41.4 (1,414)	69.6 (1,468)	55.6 (500)	37.4 (425)	56.4 (4,446)
1980-84	% (T)	79.2 (226)	8.6 (81)	4.1 (466)	47.8 (2,110)	46.2 (342)	71.7 (159)	43.9 (3,384)
Total	% (T)	95.2 (1,870)	76.7 (2,990)	34.8 (5,305)	50.1 (4,693)	52.1 (1,200)	60.5 (1,058)	57.0 (17,116)

[a] Other = MSAs 12, 13, 15, 16, 28, 29 and unknown.

[b] 1955-59 = October 1955-March 1956 ... October 1959-March 1960; etc.

Table 6. Numbers of vessels landing at least one tonne of Pacific cod from Area 4B, by initial year of landing and numbers of years of landings, October-March 1954-84.

First year[a]	Numbers of years																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Total
1954	6	9	3	1	2	3	0	0	3	1	0	1	0	0	0	0	1	0	1	1	0	1	32
1955	4	1	1	1	0	0	0	0	0	1	-	-	-	-	-	-	-	-	-	-	-	-	8
56	-	2	0	1	0	0	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
57	3	0	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
58	1	0	3	1	0	1	0	0	1	0	2	-	-	-	-	-	-	-	-	-	-	-	10
59	-	1	0	0	0	0	0	0	0	0	1	-	-	-	-	-	-	-	-	-	-	-	2
1960	2	0	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
61	1	0	1	0	0	0	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
62	1	0	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
63	1	1	2	0	0	0	0	0	0	0	0	0	0	1	-	-	-	-	-	-	-	x	5
64	-	1	1	0	0	0	1	0	0	0	0	0	0	0	1	-	-	-	-	-	x	x	4
1965	3	0	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x	4
66	-	-	1	0	1	0	0	0	0	1	-	-	-	-	-	-	-	-	x	x	x	x	3
67	1	0	0	1	0	0	0	1	-	-	-	-	-	-	-	-	-	x	x	x	x	x	3
68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x	x	x	x	0
69	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	x	x	x	x	x	x	x	1
1970	2	0	1	0	0	0	1	1	-	-	-	-	-	-	x	x	x	x	x	x	x	x	5
71	4	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x	x	x	x	x	x	x	4
72	2	0	1	-	-	-	-	-	-	-	-	-	x	x	x	x	x	x	x	x	x	x	3
73	-	1	0	0	0	0	0	1	-	-	-	x	x	x	x	x	x	x	x	x	x	x	2
74	-	1	3	0	0	0	0	0	1	-	x	x	x	x	x	x	x	x	x	x	x	x	5
1975	4	1	0	1	0	0	0	1	-	x	x	x	x	x	x	x	x	x	x	x	x	x	7
76	1	0	1	1	0	0	0	2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	5
77	5	3	0	0	1	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	9
78	2	1	0	1	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	4
79	2	3	-	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	5
1980	1	0	2	1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	4
81	3	0	1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	4
82	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0
83	1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1
Total	50	25	26	11	5	4	6	6	5	3	3	1	0	1	1	0	1	0	1	1	0	1	151
%	33.1	16.6	17.2	7.3	3.3	2.6	4.0	4.0	3.3	2.0	2.0	0.7	-	0.7	0.7	-	0.7	-	0.7	0.7	-	0.7	100.3

[a]1954 = October 1954-March 1955; etc.

Table 7. Interviewed landings (t) of Pacific cod from Area 4B, by gear class, and 5-year period, October-March 1955-84.

	Gear class[a]										
Period[b]	1 Single	2 Double	3 Double + drum	4 Shrimp	5 Single + drum	6 Gillnet	7 Danish seine	8 Mid-water	9 Pair trawl	Total	Unk.
1955-59	1,361	466	107	-	144	-	T	-	-	2,078	-
1960-64	232	291	384	-	108	11	1	-	-	1,027	-
1965-69	61	54	797	-	10	3	-	-	-	925	-
1970-74	1	88	1,410	-	-	-	-	-	-	1,499	9
1975-79	9	2	2,255	-	-	-	-	27	-	2,293	213
1980-84	-	28	1,456	-	-	-	-	T	-	1,484	-
Total	1,664	929	6,409	-	262	14	1	27	-	9,306	222
%	17.9	10.0	68.9	-	2.8	0.2	T	0.3	-	100.1	

[a]Gear class definitions:

1. Single gear. Net is towed by a single warp off one side of the vessel.
2. Double gear. Net is towed by paired warps off the stern quarters of the vessel.
3. Double + drum. Double-gear vessel possessing a drum on the stern which "wraps up" the net.
4. Shrimp. A smaller, small-mesh trawl used to capture pandalid shrimp.
5. Single + drum. Self-explanatory.
6. Gill-net. Vertical panel of web, floating or sunken, now restricted to fishing only for herring and salmon.
7. Danish seine. A trawl net laid on the bottom and then retrieved to the vessel.
8. Mid-water. A trawl net designed to catch fish in the water column. Trawl doors are not in contact with the bottom.
9. Pair trawl. A trawl net, without otter boards, which is towed by two vessels, each with a single warp attached to one wing of the net.

[b]1955-59 = October 1955-March 1956 ... October 1959-March 1960; etc.

Table 8. Mean horsepower, by tonnage class, of on-bottom trawlers landing Pacific cod (40% qualification level) from Area 4B, by gear class and 5-year period, October-March 1955-84.

Gear class	Period[a] 55-59	60-64	65-69	70-74	75-79	80-84
			Tonnage class 1 (<50 t)			
1	90	109	120	72	165	-
2	122	129	129	-	132	250
3	65	140	179	172	209	216
			Tonnage class 2 (50-99 t)			
1	300	-	-	-	-	-
2	146	175	148	198	-	-
3	261	177	208	241	311	305
			Tonnage class 3 (100-149 t)			
1	-	-	-	-	-	-
2	250	200	-	-	-	-
3	-	-	462	656	550	538
			Tonnage class 4 (150-199 t)			
1	-	-	-	-	-	-
2	-	-	-	-	-	-
3	-	-	-	483	589	565

[a]55-59 = October 1955-March 1956 ... October 1959-March 1960; etc.

Table 9. Mean tonnage, by horsepower class, of on-bottom trawlers landing Pacific cod (40% qualification level) from Area 4B, by gear class and 5-year period, October-March 1955-84.

Gear class	Period[a]					
	55-59	60-64	65-69	70-74	75-79	80-84
	Horsepower-class 1 (≤100 hp)					
1	24	24	22	15	-	-
2	31	32	-	-	-	-
3	43	40	29	29	29	-
	Horsepower-class 2 (100-199 hp)					
1	31	30	18	-	15	-
2	39	33	42	61	19	-
3	68	45	42	40	42	49
	Horsepower-class 3 (200-299 hp)					
1	26	26	-	-	-	-
2	58	59	-	61	-	-
3	-	35	39	48	43	51
	Horsepower-class 4 (300-399 hp)					
1	57	-	-	-	-	-
2	109	-	-	60	-	-
3	57	57	67	76	75	79

[a]55-59 = October 1955-March 1956 ... October 1959-March 1960; etc.

Table 10. Interviewed landings (t) of Pacific cod from Area 4B, by qualification level and percent reduction by qualification level, for gear-classes 1-3, October-March 1955-84.

Period[a]	Gear class	% qualification level				% reduction from 0% QL		
		0	20	40	60	20	40	60
1955-59	1	1,339	1,276	1,148	961	4.7	14.3	28.2
	2	466	443	404	335	4.9	13.3	28.1
	3	107	101	79	66	5.6	26.2	38.3
1960-64	1	223	211	188	147	5.4	15.7	34.1
	2	291	273	240	217	6.2	17.5	25.4
	3	364	340	292	238	6.6	19.8	34.6
1965-69	1	61	59	53	49	3.3	13.1	19.7
	2	54	50	43	32	7.4	20.4	40.7
	3	796	748	701	621	6.0	11.9	22.0
1970-74	1	1	1	T[b]	T	-	-	-
	2	88	84	79	79	4.5	10.2	10.2
	3	1,410	1,369	1,297	1,215	2.9	8.0	13.8
1975-79	1	9	9	9	9	-	-	-
	2	2	1	T	T	-	-	-
	3	2,255	2,134	1,926	1,566	5.4	14.6	30.6
1980-84	1	-	-	-	-	-	-	-
	2	28	23	20	16	17.9	28.6	42.9
	3	1,456	1,438	1,377	1,185	1.2	5.4	18.6
Total	1	1,633	1,556	1,398	1,166	4.7	14.4	28.6
	2	929	874	786	679	5.9	15.4	26.9
	3	6,388	6,130	5,672	4,891	4.0	11.2	23.4

[a] 1955-59 = October 1955-March 1956 ... October 1959-March 1960; etc.

[b] T = trace = ~0.5t

Table 11. Numbers of individual trawlers, by gear class and horsepower class, which landed Pacific cod (40% qualification level) from Area 4B during October-March 1954-84.

HP class	Gear class							Total
	1	2	3	1/2[a]	2/3	1/3	1/2/3	
1	18	2	1	-	-	1	-	22
2	8	5	17	-	1	1	2	34
3	-	1	15	-	-	-	-	16
4	-	-	18	-	-	1	-	19
5	-	-	5	-	-	-	-	5
6	-	-	4	-	-	-	-	4
7	-	-	1	-	-	-	-	1
8	-	-	3	-	-	-	-	3
9	-	-	2	-	-	-	-	2
10	-	-	1	-	-	-	-	1
1/2[b]	2	2	-	1	1	-	-	6
2/3	-	-	4	-	1	-	1	6
3/4	-	-	2	-	1	-	-	3
6/7	-	-	1	-	-	-	-	1
1/3	-	-	1	-	-	1	-	2
2/4	-	-	1	-	-	-	-	1
1/2/3	-	-	-	-	-	1	-	1
Total	28	10	76	1	4	5	3	127

[a]Changed from gear-class 1 to gear-class 2.

[b]Changed from HP-class 1 to HP-class 2.

Table 12. Cumulative interviewed landings (t) of Pacific cod from Area 4B, by horsepower class and minor statistical area (utilization 1, gear-class 3, qualification level 40%), October-March 1954-84.

	Minor statistical area							
HP class	14	17	18	19	20	Other[a]	Total	%
1	65	75	200	-	1	10	351	6.2
2	397	578	143	252	54	90	1,514	26.7
3	224	492	343	950	82	39	2,130	37.6
4	192	31	126	417	160	202	1,128	19.9
5	-	-	-	61	86	1	148	2.6
6	-	1	2	121	3	1	128	2.3
7	-	11	-	46	2	-	59	1.0
8	-	-	-	144	10	-	154	2.7
9	-	-	-	-	55	-	55	1.0
10	-	-	-	-	5	-	5	0.1
Total	878	1,188	814	1,991	458	343	5,672	100.1
%	15.5	20.9	14.4	35.1	8.1	6.0	100.0	
%HP-class 3	25.5	41.4	42.1	47.7	17.9	11.4	37.6	

[a]Other = MSA 12, 13, 15, 16, 28, 29 and unknown.

Table 13. Mean RFPs for important minor statistical areas and Area 4B, and estimated RFPs for Area 4B, by horsepower class, for gear-class 3 trawlers landing Pacific cod (40% qualification level) from Area 4B, October-March 1954-84. (Landings (t) in parentheses.)

HP class	Minor statistical area					4B	$\hat{RFP}$ (4B)
	14	17	18	19	20		
1	1.178 (65)	1.050 (75)	0.793 (200)	- (-)	-[a] (1)	0.644 (351)	0.64
2	0.969 (397)	0.930 (578)	0.860 (143)	0.847 (252)	0.977 (54)	0.916 (1,514)	0.81
3	1.000 (224)	1.000 (492)	1.000 (343)	1.000 (950)	1.000 (82)	1.000 (2,130)	1.00
4	1.045 (192)	0.855 (31)	1.051 (126)	1.093 (417)	0.972 (160)	1.176 (1,128)	1.18
5	- (-)	- (-)	- (-)	1.449 (61)	1.167 (86)	1.171 (148)	1.35
6	- (-)	1.792 (1)	-[a] (2)	1.138 (121)	-[a] (3)	1.942 (128)	1.54
7	- (-)	5.873 (11)	- (-)	1.412 (46)	1.849 (2)	2.553 (59)	1.71
8	- (-)	- (-)	- (-)	1.743 (144)	1.752 (10)	1.696 (154)	1.90
9	- (-)	- (-)	- (-)	- (-)	1.974 (55)	2.435 (55)	2.07
10	- (-)	- (-)	- (-)	- (-)	0.921 (5)	2.093 (5)	2.25

[a]No LPUE for standard class.

Table 14. Mean paired LPUEs for gear-classes 1-3, and RFPs among gear classes, by horsepower class, for Pacific cod landed for human consumption from Area 4B, October-March 1954-84. (Values in parentheses not used in subsequent analyses.)

Pairs	Gear class 1	Gear class 2	Gear class 3	Nos. of pairs	RFP 3.1	RFP 3.2
Horsepower-class 1						
1 & 2	107	132	E224[c]	10	2.093	-
2 & 3	-	142	241	7	-	1.697
1 & 3	(127)	-	(207)	9	(1.630)	-
Horsepower-class 2						
1 & 2	111	108	E133[c]	12	1.198	-
2 & 3	-	107	132	11	-	1.234
1 & 3	(145)	-	(139)	10	(0.959)	-
Horsepower-class 3						
1 & 2	136	135	E154[c]	6	1.132	-
2 & 3	-	223	255	6	-	1.143
1 & 3	(105)	-	(80)	1	(0.762)	-
Horsepower-classes 1-3						
1 & 2	115	122	E163[c]	28	1.417	-
2 & 3	-	146	195	24	-	1.336

[a] $RFP_{3.1}$ = ($\overline{LPUE}_3$, pair 1 & 2)/($\overline{LPUE}_1$, pair 1 & 2).

[b] $RFP_{3.2}$ = ($\overline{LPUE}_3$, pair 2 & 3)/($\overline{LPUE}_2$, pair 2 & 3).

[c] $\overline{LPUE}_3$ = ($\overline{LPUE}_3$, pair 2 & 3) ($\overline{LPUE}_2$, pair 1 & 2)/($\overline{LPUE}_2$, pair 2 & 3).

Table 15. Nominal and standardized landing statistics for Pacific cod from Area 4B, based on the current study, together with standardized LPUEs of Ketchen (1979 and unpublished).

Year[a]	Effort (h) Nominal	Effort (h) Standard	Landings (t)	LPUE (kg/h) Nominal	LPUE (kg/h) Standard	Ketchen's LPUE (kg/h) 1979	Ketchen's LPUE (kg/h) unpubl
1954	9333	4649	1699	182	365	190	170
1955	6699	3383	852	127	252	135	117
1956	4580	2411	755	165	313	139	117
1957	5781	3339	1126	195	337	152	123
1958	4713	2609	1234	262	473	200	158
1959	4262	2546	985	231	387	171	131
1960	3746	2263	725	194	320	141	105
1961	3319	2087	618	186	296	98	70
1962	2479	1678	352	142	210	106	74
1963	4216	3050	538	128	176	107	73
1964	2983	2245	404	135	180	92	61
1965	2656	2238	378	142	169	74	48
1966	2456	1980	609	248	308	165	104
1967	2787	2330	423	152	182	90	55
1968	2288	2019	348	152	172	64	39
1969	2728	2277	422	155	185	92	54
1970	3455	3053	786	227	257	155	90
1971	2184	1841	592	271	322	194	109
1972	1713	1504	819	478	545	118	65
1973	816	691	229	281	331	186	101
1974	1470	1264	457	311	362	204	109
1975	2369	2366	853	360	361	207	108
1976	1683	1601	618	365	386	235	120
1977	3664	3692	2261	617	612	254	129
1978	1834	2129	1115	608	524	-	107
1979	3251	3690	1344	413	364	-	45
1980	2231	2483	982	440	395	-	107
1981	2503	2735	969	387	354	-	-
1982	752	803	286	380	356	-	-
1983	529	517	194	367	375	-	-

[a]1954 = October 1954-March 1955; etc.

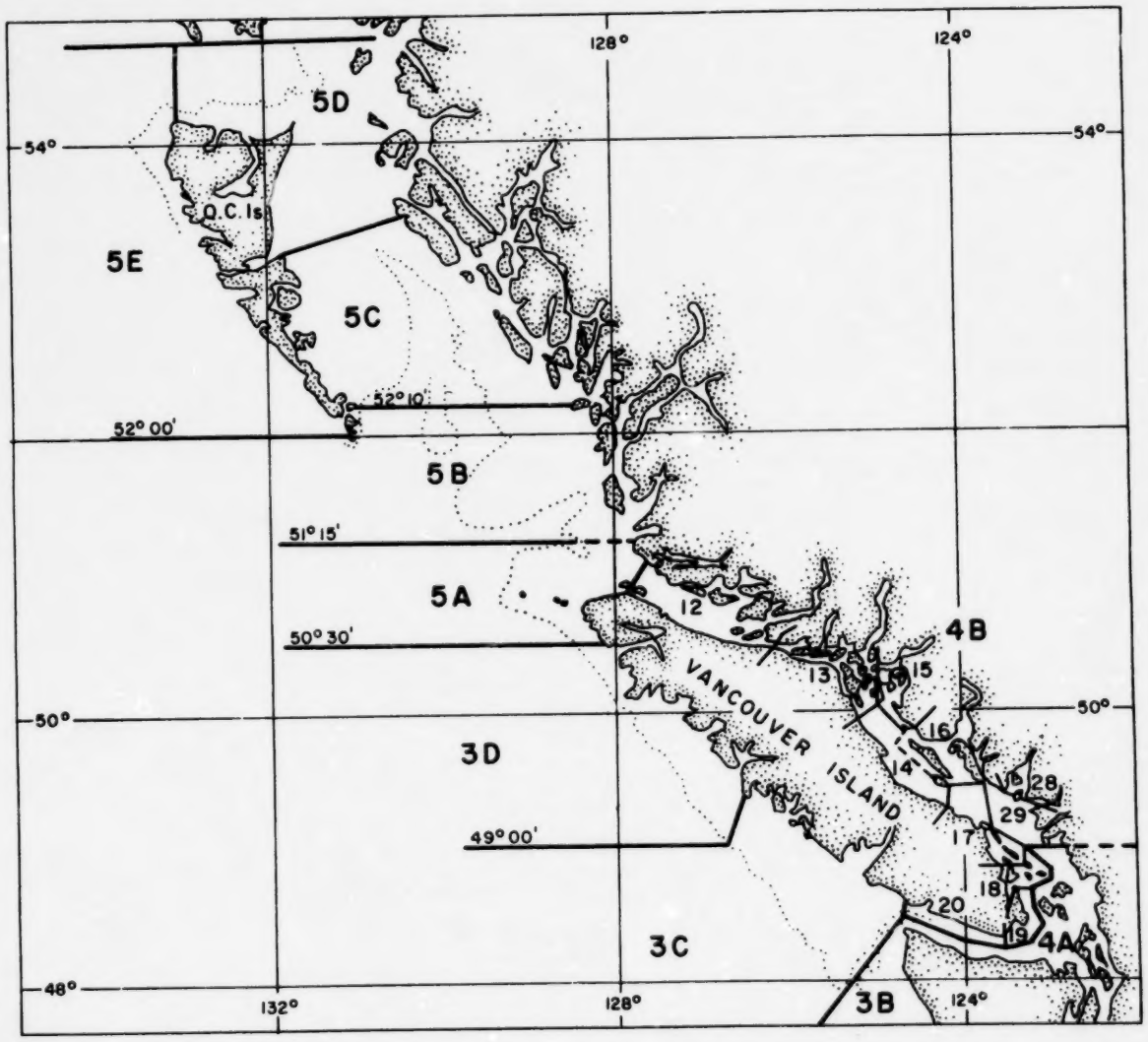

Fig. 1. Major statistical areas for Canada-U.S. groundfish landings, and Canadian minor statistical areas in Area 4B.

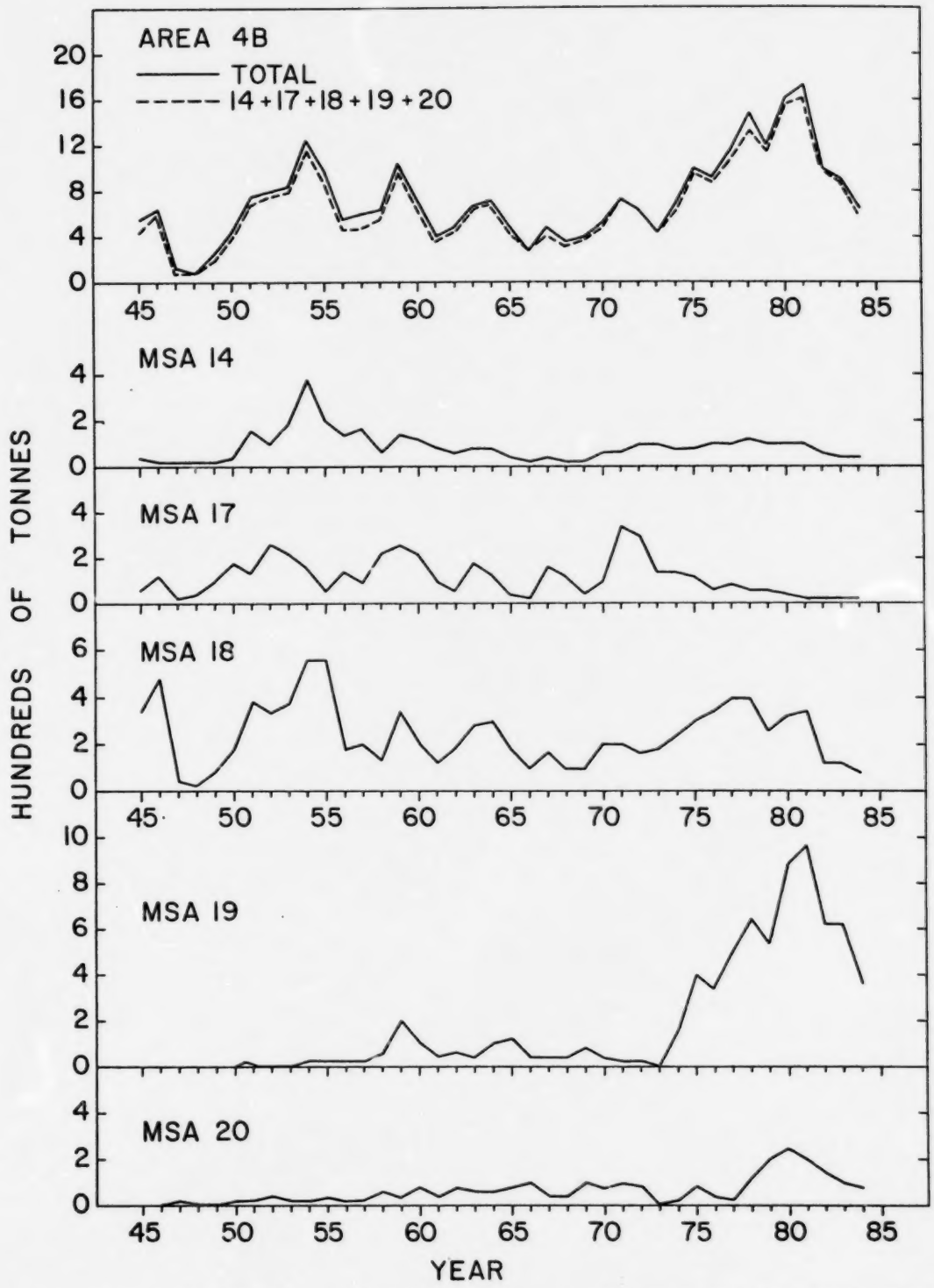

Fig. 2. Total landings (t) of Pacific cod from Area 4B, and important MSAs, January-December 1945-84.

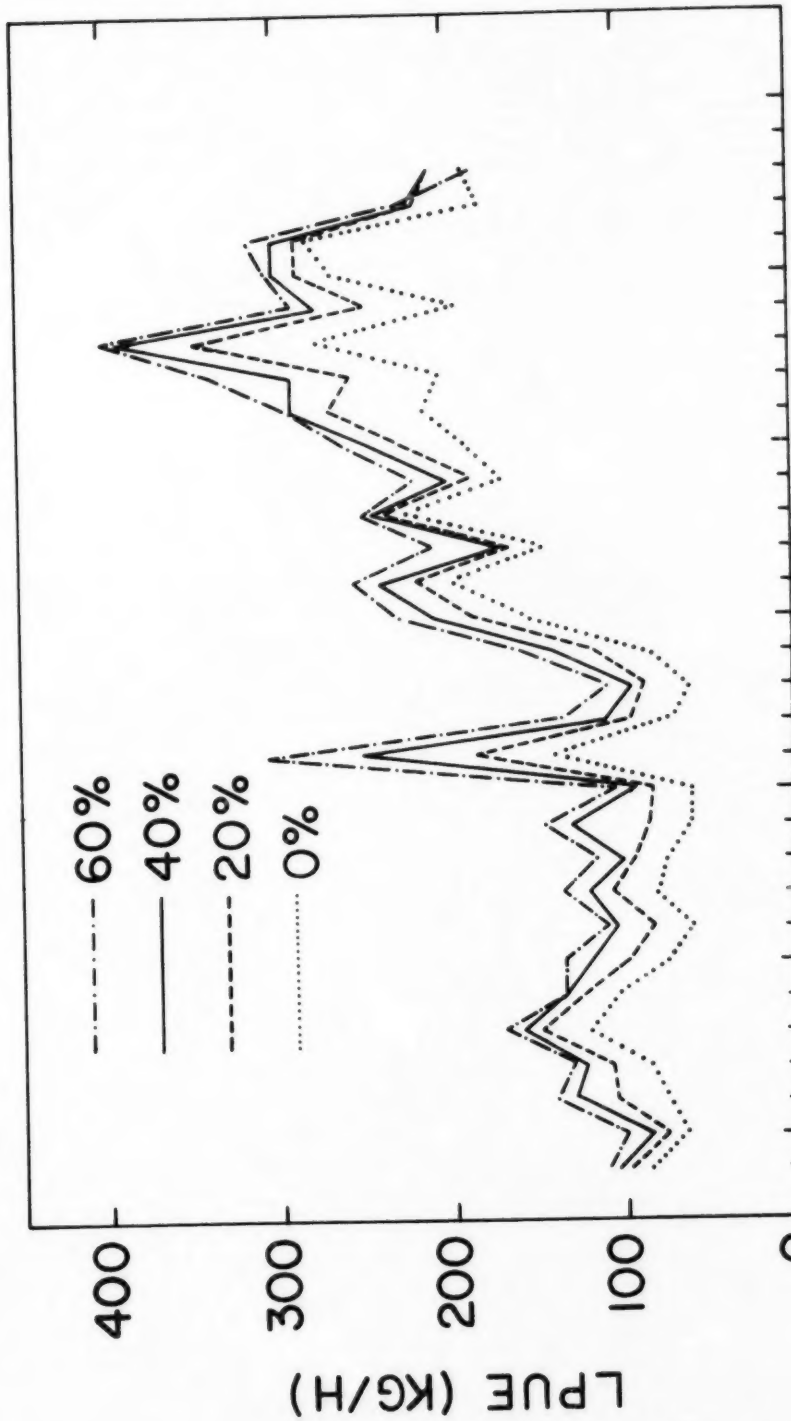

Fig. 3. LPUEs (kg/h) of Pacific cod from Area 4B, by qualification level, for gear-classes 1-9, October-March 1954-84.

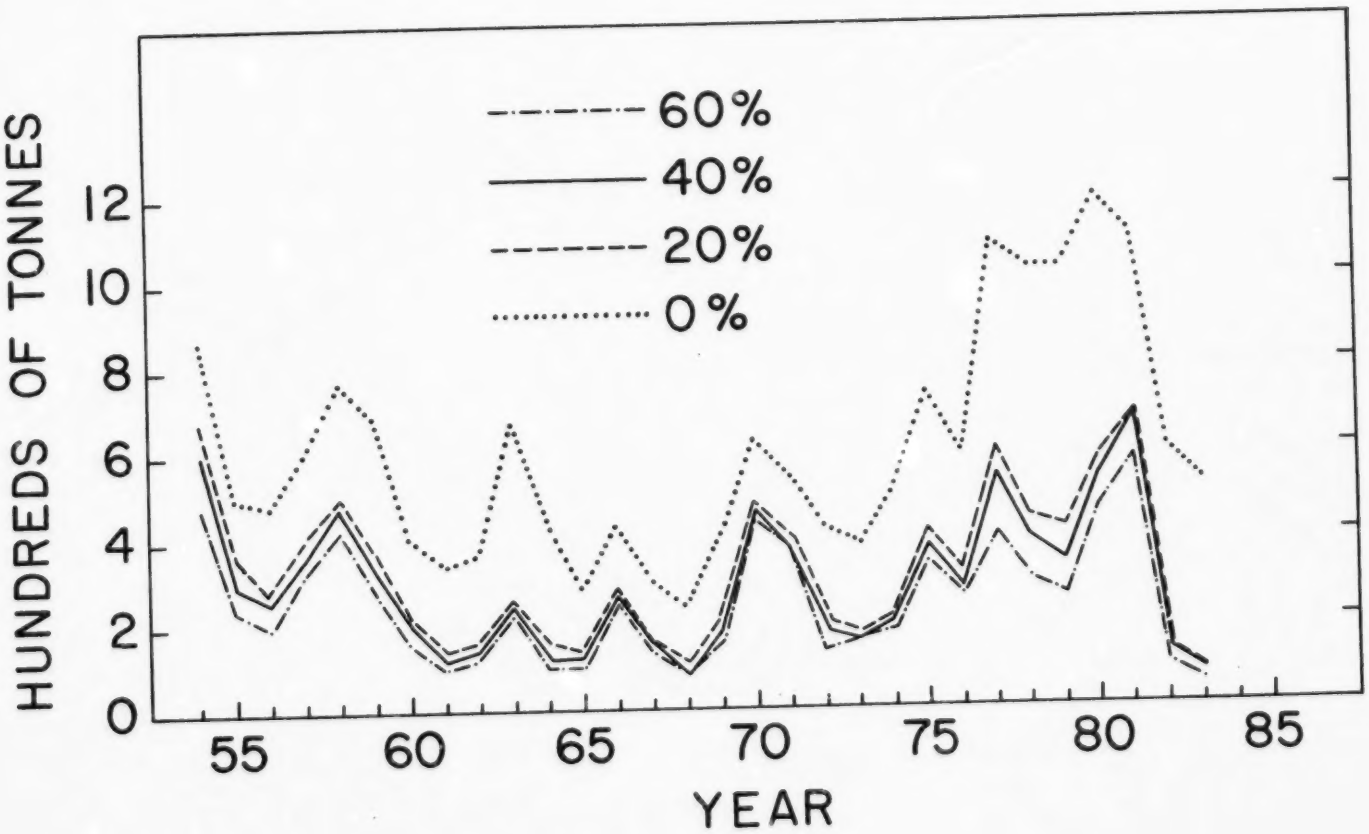

Fig. 4. Interviewed landings (t) of Pacific cod from Area 4B, by qualification level, for gear-classes 1-9, October-March 1954-84.

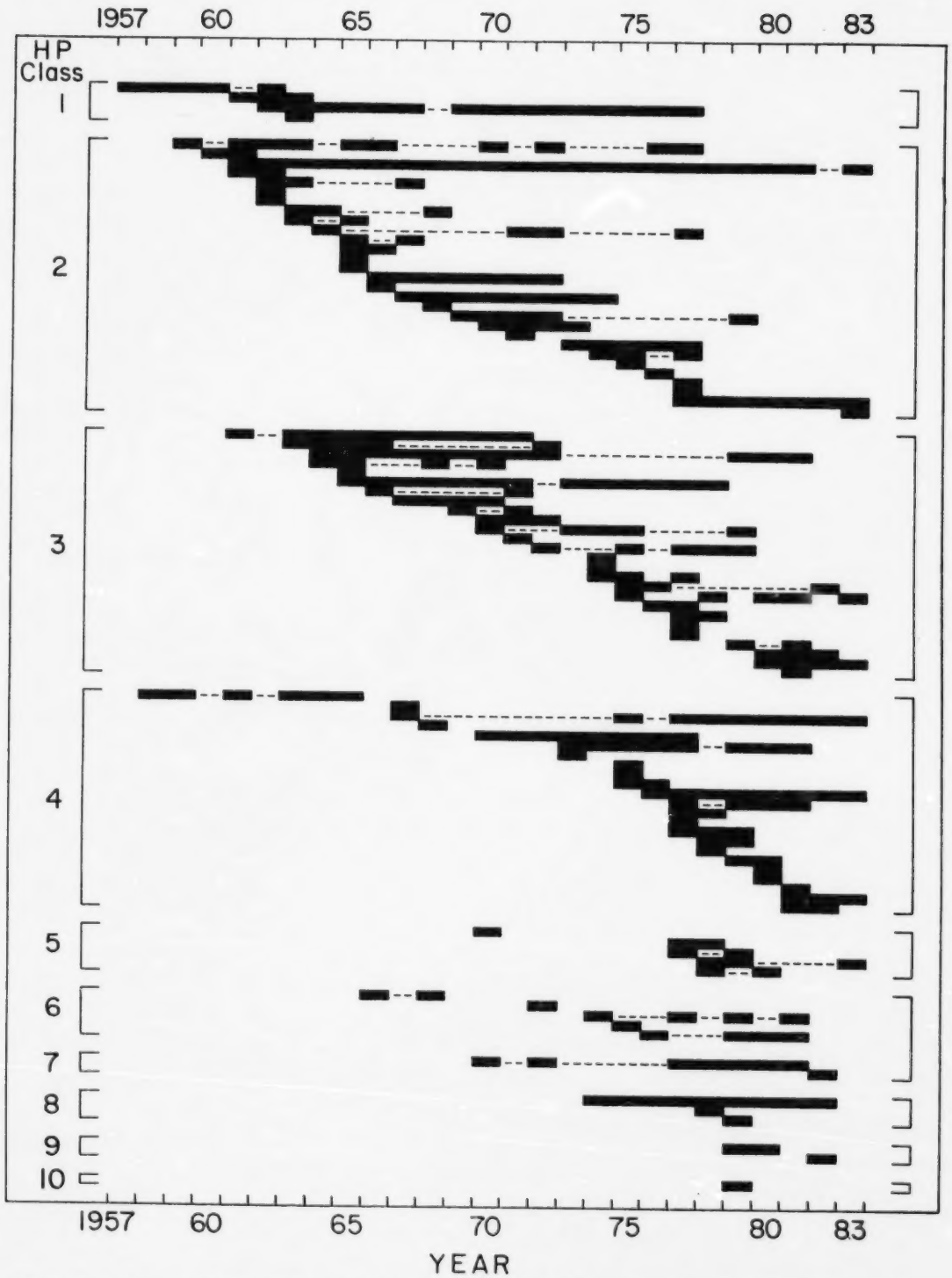

Fig. 5. Time of participation of individual gear class 3 trawlers, by horsepower class and year, landing Pacific cod from Area 4B, October-March 1954-84.

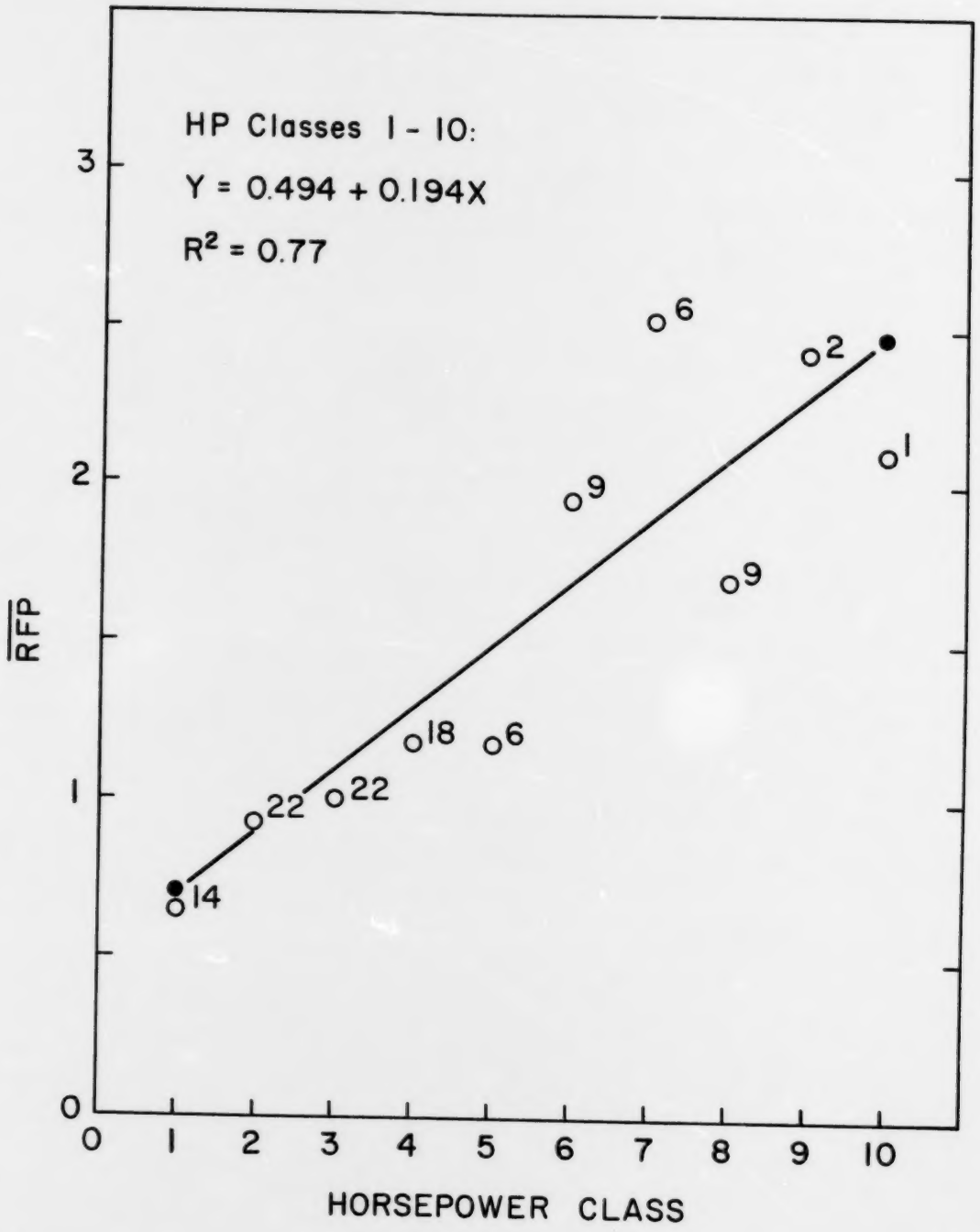

Fig. 6. Regression of $\overline{RFP}$s on horsepower class for Pacific cod landings from Area 4B, October-March 1957-84. (Utilization 1; gear class 3; 40% qualification level.)

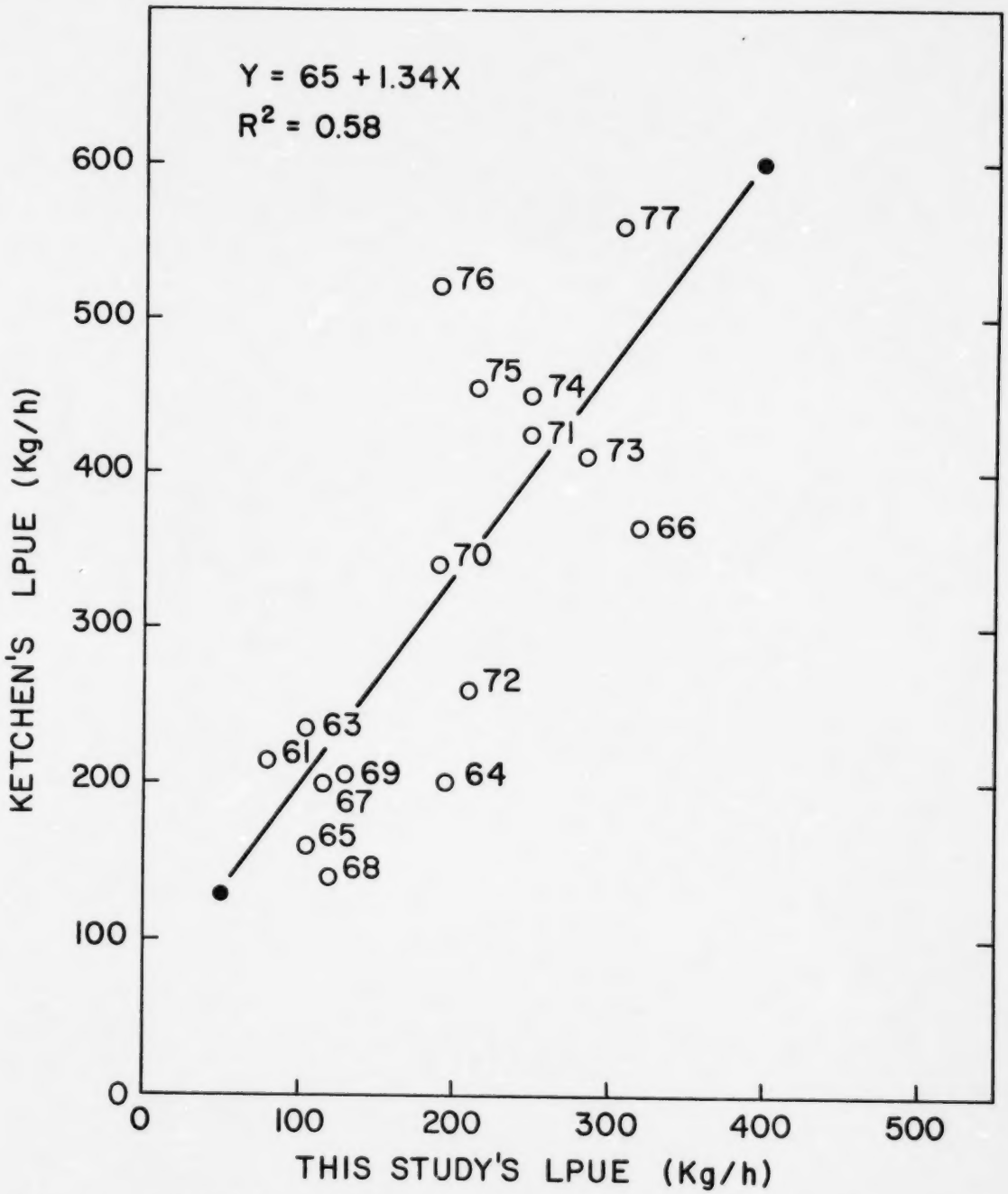

Fig. 7. Regression of Ketchen's standard LPUEs on standard LPUEs of this study for Pacific cod landed from Area 4B, October-March 1961-62 and 1963-78.

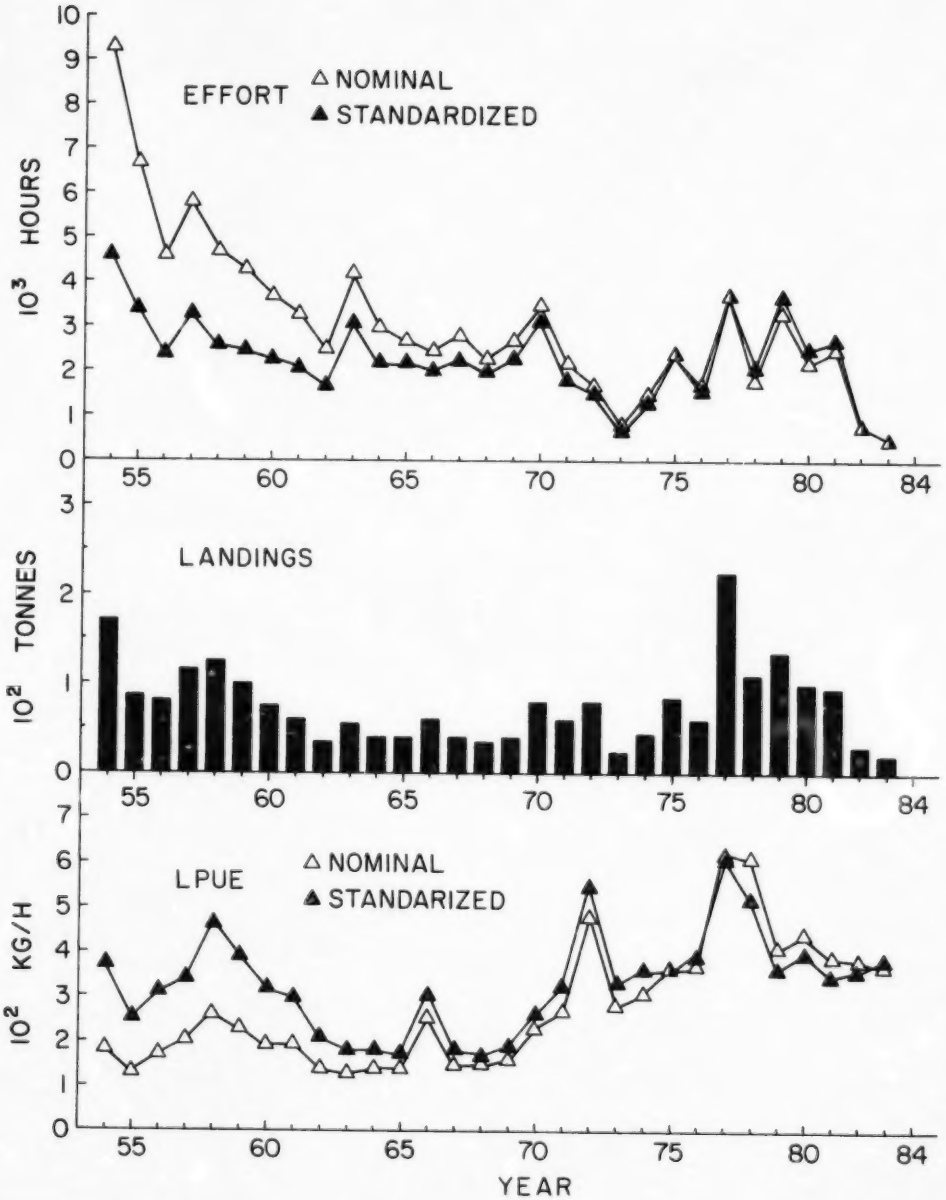

Fig. 8. Nominal and standardized landing statistics for Pacific cod from Area 4B, October-March 1954-84.

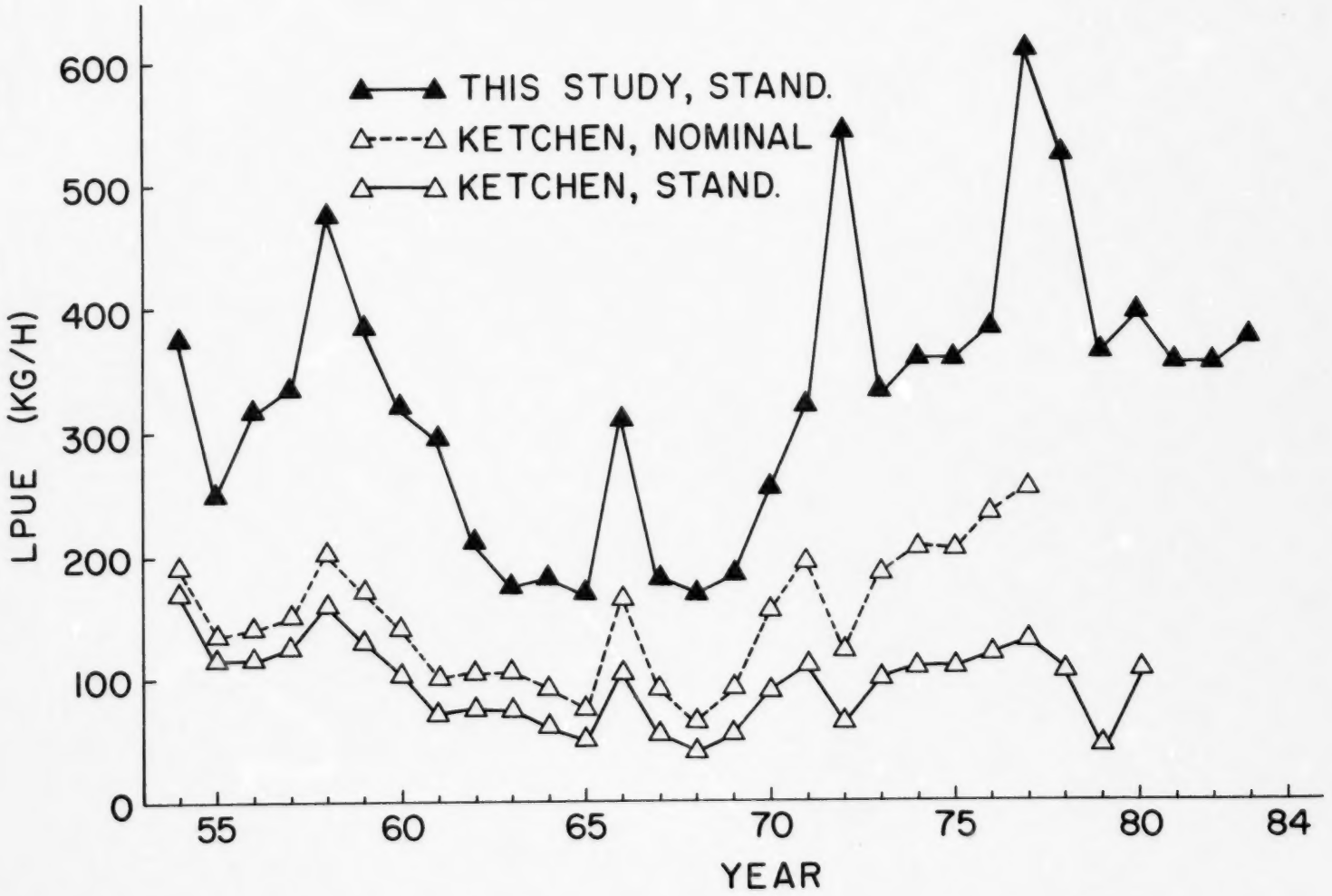

Fig. 9. Nominal and standardized LPUEs (kg/h) by study, for Pacific cod landed from Area 4B, October-March 1954-84. (Ketchen, Nominal from Ketchen 1979; Ketchen, Stand. from Ketchen et al. 1983).

Appendix table 1. Computation of relative fishing power (RFP), by horsepower class for vessels in gear-class 1 landing Pacific cod, for human consumption, from Area 4B, October-March 1954-84. (Qualification level = 40%).

a. LPUEs (kg/h) by horsepower class and year, and RFPs by horsepower class.

Hp class	1954[a]	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	RFP
1 (0-99)	101	84	125	107	152	110	66	123	82	123	95	-	288	-	-	101	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.993
2 (100-199)	120	86	142	118	169	107	100	82	26	73	-	-	242	70	112	-	-	-	-	-	-	-	458	176	-	-	-	-	-	-	0.772
3 (200-299)	-	-	-	167	165	240	99	105	39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.000
4 (300-399)	-	147	174	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000
5 (400-499)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000
6 (500-599)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000
7 (600-699)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000
8 (700-799)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000
9 (800-899)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000
10 (900+)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000
Mean	109	86	131	113	154	140	87	95	67	100	94	-	276	77	100	105	-	-	-	-	-	-	444	200	-	-	-	-	-	-	

b. Numbers of records from interviewed landings by horsepower class and year.

Hp class	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	Total
1 (0-99)	157	112	86	79	71	35	26	15	7	8	2	-	7	-	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	610
2 (100-199)	153	89	30	50	9	17	14	13	3	12	-	-	7	11	2	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-	414
3 (200-299)	-	-	-	5	11	13	9	1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	44
4 (300-399)	-	6	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14
5 (400-499)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6 (500-599)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7 (600-699)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8 (700-799)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9 (800-899)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10 (900+)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	310	207	124	134	91	65	49	29	15	20	2	-	14	11	2	3	2	-	-	-	-	-	2	2	-	-	-	-	-	-	1082

c. Interviewed landings (t), by horsepower class and year.

Hp class	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	Total
1 (0-99)	271	174	157	140	224	65	20	21	12	28	12	-	35	-	-	2	Tr	-	-	-	-	-	-	-	-	-	-	-	-	-	1161
2 (100-199)	252	104	38	84	19	24	29	29	1	14	-	-	12	3	1	-	-	-	-	-	-	-	8	1	-	-	-	-	-	-	619
3 (200-299)	-	-	-	11	19	60	16	5	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
4 (300-399)	-	11	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	29
5 (400-499)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6 (500-599)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7 (600-699)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8 (700-799)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9 (800-899)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10 (900+)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	523	289	213	235	262	149	65	55	14	42	12	-	47	3	1	2	-	-	-	-	-	-	8	1	-	-	-	-	-	-	1921

d. Interviewed effort (h) by horsepower class and year.

Hp class	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	Total
1 (0-99)	2695	2064	1256	1304	1467	591	298	170	148	223	128		121	-	-	19	4	-	-	-	-	-	-	-	-	-	-	-	-	-	10488
2 (100-199)	2101	1204	265	716	114	222	290	361	36	198	-	-	49	39	10	-	-	-	-	-	-	-	18	5	-	-	-	-	-	-	5628
3 (200-299)	-	-	-	66	117	250	159	48	26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	666
4 (300-399)	-	75	101	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	176
5 (400-499)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6 (500-599)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7 (600-699)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8 (700-799)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9 (800-899)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10 (900+)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	4796	3343	1622	2086	1698	1063	747	579	210	421	128	-	170	39	10	19	4	-	-	-	-	-	18	5	-	-	-	-	-	-	16958

e. Interviewed landings(t), by year, for which no hp was designated.

1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
-	-	-	-	-	22	7	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

[a]1954 = October 1954 - March 1955, etc.

Appendix table 2. Computation of relative fishing power (RFP), by horsepower class for vessels in gear-class 2 landing Pacific cod, for human consumption, from area 48, October-March 1954-1984. (Qualification level = 40%).

a. LPUEs (kg/h) by horsepower class and year, and RFPs by horsepower class.

Hp class	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	RFP
1 (0-99)	96	100	131	66	135	65	293	96	308	32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 (100-199)	-	119	124	93	143	91	137	141	111	79	101	67	159	52	44	-	199	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.244
3 (200-299)	-	-	86	126	172	125	132	64	188	-	-	-	-	-	-	-	-	419	372	231	-	-	-	-	-	-	140	112	-	-	1.000
4 (300-399)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	359	-	-	-	-	-	-	-	-	-	-	-	-	0.857
5 (400-499)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000
6 (500-599)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000
7 (600-699)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000
8 (700-799)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000
9 (800-899)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000
10 (900+)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000
Mean	95	101	121	92	150	104	136	120	157	78	99	69	157	51	47	-	197	417	379	250	-	-	-	-	-	-	137	108	-	-	

b. Numbers of records from interviewed landings, by horsepower class and year.

Hp class	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	RFP
1 (0-99)	26	4	7	10	6	4	1	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	63
2 (100-199)	2	3	17	16	33	49	19	13	16	55	13	9	7	12	8	-	6	-	-	-	-	-	-	-	-	2	-	-	-	-	280
3 (200-299)	-	1	3	16	33	24	21	4	6	-	1	-	-	-	-	-	-	2	3	1	-	-	-	-	-	-	4	4	-	-	123
4 (300-399)	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	3
5 (400-499)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6 (500-599)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7 (600-699)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8 (700-799)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9 (800-899)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10 (900+)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	28	8	27	43	72	77	41	20	23	56	14	9	7	12	8	-	6	4	3	1	-	-	-	-	-	2	4	4	-	-	469

c. Interviewed landings(t), by horsepower class and year.

Hp class	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	Total
1 (0-99)	68	16	14	9	27	2	1	4	11	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	153
2 (100-199)	Tr	4	25	28	80	64	37	17	21	56	22	14	20	5	4	-	23	-	-	-	-	-	-	-	-	Tr	-	-	-	-	420
3 (200-299)	-	Tr	5	16	58	56	49	2	19	-	Tr	-	-	-	-	-	-	42	11	2	-	-	-	-	-	-	16	4	-	-	280
4 (300-399)	-	-	-	Tr	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
5 (400-499)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6 (500-599)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7 (600-699)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8 (700-799)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9 (800-899)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10 (900+)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	68	20	44	53	165	122	87	23	51	57	22	14	20	5	4	-	23	43	11	2	-	-	-	-	-	-	16	4	-	-	854

d. Interviewed effort(h) by horsepower class and year.

Hp class	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	Total
1 (0-99)	711	163	104	143	200	31	2	41	36	28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1459
2 (100-199)	6	33	204	302	559	700	271	124	187	705	219	204	127	99	85	-	117	-	-	-	-	-	-	-	-	7	-	-	-	-	3949
3 (200-299)	-	3	57	126	339	447	369	26	102	-	3	-	-	-	-	-	-	99	29	8	-	-	-	-	-	-	117	37	-	-	1762
4 (300-399)	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	11
5 (400-499)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6 (500-599)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7 (600-699)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8 (700-799)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9 (800-899)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10 (900+)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	717	199	365	578	1098	1178	642	191	325	733	222	204	127	99	85	-	117	103	29	8	-	-	-	-	-	7	117	37	-	-	7181

1954 = October 1954 - March 1955

Appendix table 3. Computation of relative fishing power (RFP), by horsepower class for vessels in gear class 3 landing Pacific cod, for human consumption, from Area 4B, October-March 1954-84. (Qualification level = 40%).

a. LPUEs (kg/h) by horsepower class and year, and RFPs by horsepower class.

Hp class	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	RFP
1 (0-99)	-	-	-	383	377	198	249	86	262	133	71	84	108	77	-	139	62	129	136	85	66	120	215	103	-	-	-	-	-	-	0.644
2 (100-199)	-	-	-	-	-	41	145	93	100	101	135	106	195	129	79	156	332	259	160	242	165	248	261	244	279	178	344	205	126	136	0.916
3 (200-299)	-	-	-	-	-	-	-	80	-	106	195	103	319	113	118	132	190	251	211	284	248	215	188	311	423	140	345	359	291	332	1.000
4 (300-399)	-	-	-	-	115	166	-	-	-	146	113	98	-	117	-	-	75	192	139	667	648	258	460	316	321	294	250	246	188	290	1.176
5 (400-499)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	283	-	-	-	-	-	-	404	435	258	329	-	-	137	1.171
6 (500-599)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	86	-	-	-	324	-	543	413	985	680	-	251	342	322	-	-	1.942
7 (600-699)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1803	-	-	-	-	-	-	378	604	276	257	169	-	-	2.553
8 (700-799)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	472	820	283	156	608	458	229	506	—	—	1.696
9 (800-899)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	558	305	-	-	-	2.435
10 (900+)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	293	-	-	-	-	2.093
Mean	-	-	-	380	301	180	197	84	111	112	152	103	258	119	103	142	212	225	162	244	199	244	285	289	394	276	311	303	226	211	

b. Numbers of records from interviewed landings, by horsepower class and year.

Hp class	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	Total
1 (0-99)	-	-	-	7	9	6	8	2	3	30	2	5	2	7	-	8	7	14	8	2	8	6	7	1	-	-	-	-	-	-	142
2 (100-199)	-	-	-	-	-	1	2	10	25	33	27	34	33	43	32	39	33	40	35	23	57	21	32	38	22	17	14	10	10	12	643
3 (200-299)	-	-	-	-	-	-	-	11	-	36	20	25	39	30	46	57	74	28	13	6	23	49	17	50	23	12	34	32	7	5	637
4 (300-399)	-	-	-	-	1	1	-	1	-	4	1	1	-	4	1	-	8	6	9	3	7	44	17	39	25	41	37	49	19	16	334
5 (400-499)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	2	10	4	1	-	-	2	23
6 (500-599)	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	1	-	1	2	1	1	-	2	4	8	-	-	22
7 (600-699)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	1	1	1	1	5	1	-	12
8 (700-799)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	1	2	4	2	1	3	2	-	19
9 (800-899)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	1	-	5
10 (900+)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	2
Total	-	-	-	7	10	8	10	24	28	103	50	65	75	84	80	104	127	88	67	34	98	124	75	134	85	83	94	107	40	35	1839

c. Interviewed landings (t), by horsepower class and year.

Hp class	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	Total
1 (0-99)	-	-	-	35	20	20	8	1	7	38	7	10	2	3	-	27	22	46	30	9	9	15	38	4	-	-	-	-	-	-	351
2 (100-199)	-	-	-	-	-	1	4	10	38	37	22	41	64	73	24	67	204	197	77	76	86	67	77	148	42	37	53	34	11	24	1514
3 (200-299)	-	-	-	-	-	-	-	16	-	44	51	53	129	56	58	84	177	96	34	51	67	130	44	159	98	25	272	389	69	28	2130
4 (300-399)	-	-	-	-	2	1	-	Tr	-	7	2	2	-	7	Tr	-	8	8	17	17	19	117	90	190	113	150	141	183	30	24	1128
5 (400-499)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	-	-	-	-	-	-	20	64	29	10	-	-	6	148
6 (500-599)	-	-	-	-	-	-	-	-	-	-	-	-	Tr	-	1	-	-	-	2	-	1	29	12	7	-	6	30	40	-	-	128
7 (600-699)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	-	Tr	-	-	-	-	1	21	14	2	10	Tr	-	59
8 (700-799)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	20	4	3	66	32	1	10	4	-	154
9 (800-899)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	49	6	-	Tr	-	55
10 (900+)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	5
Total	-	-	-	35	22	22	12	27	45	126	82	106	195	139	83	178	441	347	160	153	196	378	265	532	404	347	515	666	114	82	5672

d. Interviewed effort(h), by horsepower class and year.

Hp class	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	Total
1 (0-99)	-	-	-	92	54	102	34	15	25	287	93	116	17	44	-	193	349	354	220	104	131	128	176	42	-	-	-	-	-	-	2576
2 (100-199)	-	-	-	-	-	14	27	102	380	370	166	384	331	566	308	429	615	762	480	315	522	268	295	605	152	210	153	168	87	181	7890
3 (200-299)	-	-	-	-	-	-	-	202	-	417	264	511	404	500	493	632	935	383	163	181	271	604	237	511	232	178	788	1084	236	83	9309
4 (330-399)	-	-	-	-	19	6	-	2	-	51	15	20	-	58	2	-	111	43	119	26	30	455	195	600	352	511	565	743	159	82	4164
5 (400-499)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	66	-	-	-	-	-	-	50	148	111	31	-	-	42	448
6 (500-599)	-	-	-	-	-	-	-	-	-	-	-	-	4	-	6	-	-	-	5	-	1	71	12	10	-	23	88	123	-	-	343
7 (600-699)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	2	-	-	-	-	2	34	52	9	60	3	-	168
8 (700-799)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	29	24	14	21	108	69	4	19	18	-	306
9 (800-899)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	88	19	-	3	-	110
10 (900+)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16	-	-	-	-	16
Total	-	-	-	92	73	122	61	321	405	1125	538	1031	756	1168	809	1254	2082	1542	989	626	984	1550	929	1841	1026	1258	1657	2197	506	388	25330

e. Interviewed landings(t), by year, for which no hp was designated.

1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
-	-	-	-	-	-	-	-	10	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1954 = October 1954 - March 1955

Appendix table 4. Effort corrected for change in average horsepower of class 3 trawlers. (Revised data from Table 8 in Ketchen 1979.)

	All-species (human consumption)						
Year[a]	Original standard effort (h)	HP factor[c]	New standard effort (h)	landings[d] (10^3 lb)	LPUE (lb/h)	Pacific cod LPUE (lb/h)	English sole LPUE (lb/h)
1954	4490	1.1154	5008	2968	593	375	69
55	4635	1.1539	5348	2123	397	258	83
56	3952	1.1923	4712	2162	459	257	91
57	4260	1.2308	5243	2232	426	272	78
58	3768	1.2693	4783	2312	483	347	55
59	3959	1.3077	5177	2736	528	289	53
1960	2886	1.3462	3885	1905	490	231	60
61	3518	1.3847	4871	1699	349	155	75
62	3385	1.4231	4817	1513	314	164	51
63	6320	1.4616	9237	2427	263	161	44
64	4733	1.5000	7100	1893	266	135	64
1965	3743	1.5385	5759	1426	248	105	64
66	2561	1.5770	4039	1585	392	230	76
67	3311	1.6154	5349	1258	235	122	46
68	3373	1.6539	5579	1157	207	86	47
69	4294	1.6923	7267	1503	207	120	40
1970	4006	1.7308	6934	1931	278	198	37
71	2739	1.7693	4846	1583	327	241	37
72	3490	1.8077	6309	1361	216	143	30
73	2036	1.8462	3759	1073	285	222	27
74	2449	1.8847	4616	1484	321	239	40
1975	3577	1.9231	6879	2157	314	238	30
76	2532	1.9616	4967	1848	372	264	52
77	3248	2.000	6496	2463	379	284	51
78	4737	2.000	9474	2785	294	235	18
79	11280	2.000	22560	2921	129	100	10
1980	3680	2.000	7368	2069	281	235	11

[a]1954 = October 1954 - March 1955; etc.

[b]From Table 8 in Ketchen 1979.

[c]Horsepower of class 3 trawlers determined from average values over study period showed an increase (least squares) of 0.03846, or 3.846% per year. This increase is used in developing the factor to adjust effort for change in horsepower. Not shown are the HP factors for 1951-52 (1.0000), 1952-53 (1.0385), and 1953-54 (1.0770).

[d]Excludes landings of walleye pollock (human consumption), spiny dogfish, mink food (all species), and reduction (all species).